Response to the PCT Written Opinion

(1) In the PCT Notice dated May 18, 2004, the Examiner is stating as follows: "The invention pertaining to claims 1, 4, and 6 to 9 does not possess inventive step based on Document 1 (JP2002-352483). The reason for this is that Document 1 describes the method of mixing Ge powder having an average grain size of 100 μm and Cr powder having an average grain size of 100 μm or 50 μm, and of sintering this via hot pressing at 870°C and under a pressure of 24.5MPa, and the relative density of the obtained Ge-Cr alloy target being 93 to 99%. The manufacturing method of the target described in Document 1 is the same as the method described in the Examples of the present Description, and the target obtained by the same method is also acknowledged to be the same. Considering the explanation on page 6, lines 5 to 7 of the present Description, the probability that the target having a relative density of 95% or more described in Document 1 is formed by using Ge powder having a BET specific surface area of $0.4m^2/g$ or less is high. Thus, the method described in Document 1 is substantially the same as the method described in claims 6 to 9."

The Examiner also mentioned that "(1) Although Examples 1 to 3 describe the grain size of the Cr powder, there is no indication of the BET surface area, and the relationship between these Examples and the invention claimed in claims 6 to 9 is unclear. (2) Claim 7 is dependent on an erroneous (deleted) claim, and is unclear."

Nevertheless, the cited Document 1 is entirely different from the present invention, and does not in any way disclose or suggest the constitution, operation, effect or technical spirit of the present invention. Thus, the present invention clearly possesses inventive step. Also, the indicated erroneous descriptions have been corrected as explained below.

The reason is now explained in detail.

(2) The gist of the invention of independent claims 1 and 6, as evident from the Amendment filed on the same date (amendment under PCT Article 34), is as follows: Claim 1. "A Ge-Cr alloy sputtering target containing 5 to 50at% of Cr, wherein the relative density of the target is 97% or more, the density variation of the target is within ±1.5%, and, in the X-ray diffraction peak, the ratio B/A of the maximum peak intensity A of Ge phase in a 2θ range of 20° to 30° and the maximum peak intensity B of GeCr compound phase in a 2θ range of 30° to 40° is 0.18 or more;" Claim 6 "A manufacturing method of a Ge-Cr alloy sputtering target, comprising the steps of evenly dispersing and mixing Cr powder of 75 μm or less and Ge powder of 250 μm or less having a BET specific surface area of 0.1 to 0.4m^2/g, and thereafter performing sintering thereto;" and Claim 7 "A manufacturing method of a Ge-Cr alloy sputtering target according to claim 1 or claim 4, comprising the steps of evenly dispersing and mixing Cr powder of 75 μm or less and Ge powder of 250 μm or less having a BET specific surface area of 0.1 to 0.4m^2/g, and thereafter performing sintering thereto." (Incidentally, claim 8 has been deleted since it overlaps with claims 6 and 7.)

Moreover, as explained in the section of "Effect of the Invention" in the Description, the present invention possesses a special operation and effect as follows: "When forming a GeCrN thin film by reactive sputtering employing the high density Ge-Cr alloy sputtering target of the present invention, the variation of the deposition speed and the accompanying composition deviation can be effectively suppressed, and a superior effect is yielded in that stable sputtering characteristics can be obtained. As a result, the incidence rate of defective products can be significantly reduced. Further, upon sputtering, the generation of particles and nodules can be reduced, and the film thickness uniformity can also be improved."

Subject to the foregoing explanation, the present invention is now compared with Document 1. Further, since claims 4 and 7 to 9 are all dependent on claim 1 or claim 6, claim 1 and claim 6 are foremost compared with Document 1.

(3) Incidentally, claim 7 has been appropriately corrected under PCT Article 34, and the deleted claim has been exempt from the claims. Thus, the foregoing erroneous description and indication of (2) above have been overcome.

(4) Although the Examiner is commenting that the Examples of the present invention and Document 1 are the same, there are several significantly different points with respect to the characteristics of the present invention and Document 1.

One is that Document 1 is prescribing powder with the average grain size. When the average grain size is prescribed, needless to say, there will be particles having a grain size that is larger than the average grain size, and the variation of the grain size will increase.

Meanwhile, the present invention prescribes powder with a minus sieve grain size. Thus, particles of a grain size that are greater than the prescribed size do not exist. This difference is significant.

In other words, the particle size is reflected in the sintering reaction, and the reaction often becomes uneven, and the density variation will occur. Mother phase Ge powder and Cr powder with a difference in specific gravity, the latter being less, must be evenly dispersed. Therefore, it is particularly important to make Cr powder a minus sieve of 75 μm or less. This point is clearly different from Document 1.

Next, Document 1 does not provide a clear description regarding the BET specific surface area. The invention of claim 6 uses Ge powder having a BET specific surface area of 0.1 to 0.4m^2/g. When converting this BET specific surface area of 0.1 to 0.4m^2/g for Ge powder into a

grain size, it will be 2 to 11 μm, indicating that this powder possesses sinterability corresponding thereto. This is clearly different from the Ge powder having an average grain size of 100 μm as described in Document 1.

In sintering, since the surface energy will drive the reaction, the foregoing adjustment will enable the favorable progress of the sintering reaction of Ge and Cr and of Ge and Ge, and will result in uniform sintered structure.

Further, Document 1 describes wet blending of Ge powder and Cr powder. Contrarily, the present invention performs dry blending. Wet blending causes oxidation, which causes other problems. As described later, even when trying to obtain the same structure, the oxidation will make it impossible to attain sufficient density. This difference is also significant.

(5) Next, differences in the structure of the manufactured sputtering targets are explained. With the target obtained in the present invention, Ge-Cr compound particles are scattered in the Ge phase. The Ge-Cr compound obtained in the Examples is $Cr_{11}Ge_{19}$. Mainly this compound is detected in XRD in a 2 θ range of 30 to 40° prescribed in claim 1, or the CrGe compound shown in the attached Ge-Cr phase diagram may also be detected.

In Document 1, the compounds described in Example 1 and Example 2 contain a Cr rich Ge-Cr phase (Cr_3Ge), and is clearly different from the present invention in terms of structure. The compound obtained in Example 3 of Document 1 seems to be the $Cr_{11}Ge_{19}$ phase scattered in the Ge phase. However, the relative density in this Example is 93%, and inferior to and clearly different from the relative density 97% or more of the present invention. Thus, this suggests a clear difference in the conditions of manufacturing between in Document 1 and in the present invention.

Although the Examiner is commenting that "Considering the explanation on page 6, lines 5 to 7 of the present Description, the probability that the target having a relative density of 95% or more described in Document 1 is formed by using Ge powder having a BET specific surface area of $0.4m^2/g$ or less is high," since said explanation describes "Moreover, if Cr powder exceeding minus sieve 75 μm and Ge powder exceeding minus sieve 250 μm having BET specific surface area $0.4m^2/g$ or more are used for sintering, a relative density of 95% or more cannot be attained, the variation of the deposition speed and film composition will increase, and the production yield will decrease," it is evident that the condition of Document 1 where the relative density is 93% does not satisfy the conditions of the present invention. Thus, the present invention and Document 1 do not bear any similarities with respect to this point as well.

Further, since a Cr rich phase (Cr_3Ge) is contained in the target obtained in Example 1 and Example 2 of Document 1, it cannot be said that Ge and Cr are being sintered evenly. In other words, since the attached Ge-Cr phase diagram shows that the Cr_3Ge is stable in Ge-Cr alloy containing 75-80%Cr, the existence of this compound suggests that a manufacturing method causes an uneven sintering of the raw materials of Cr and Ge.

(6) Accordingly, Document 1 significantly lacks grounds for indicating that the invention of claims 1 and 6 could have been easily achieved based on Document 1, and the technical spirit of the present invention and the technical spirit of Document 1 are clearly different. Therefore, the present invention cannot be achieved with Document 1.

As described above, claims 4 and 7 to 9 are dependent on claim 1 or claim 6. Thus, since claim 1 and claim 6 cannot be denied novelty and inventive step based on Document 1, it is evident that claims 4 and 7 to 9 also possess novelty and inventive step.

Accordingly, we believe that the invention of this PCT application (claims 1, 4, 6 to 9) possesses patentability

Appendix 1 Ge-Cr Phase Diagram

Appendix 1

Ge-Cr Phase Diagram